

XX. *On certain temperature forms of Japanese Butterflies.*
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IN the following paper I have used the term "temperature" in preference to "seasonal," as the latter word appears to me to insufficiently indicate the changes which take place in many of the Japanese butterflies which appear more than once in the course of a year.

The changes appear to me to depend not so much on the season of the appearance of the perfect insect as on the temperature the larva has borne during its existence; frequently also an odd specimen of the spring form will put in an appearance in summer, and again the summer forms will sometimes appear late in the autumn. To illustrate this I will give an instance which came under my notice five years ago. I then visited Boshu and Kadzusa, on the opposite side of Tokiyo Bay, the extremity of Boshu being always markedly warmer than the neighbourhood of Yokohama. It was in the month of November, and I found there the black summer form of *Polyommatus Phleas* in abundance, while as I worked further north up the Bay this was replaced by the brightly-coloured spring and autumn form.

Our seasons are pretty evenly divided; the latter half of December, all January, February, and the first half of March being winter; the latter part of March, all April, May, and June, spring; July, August, September, summer; October, November, and the first half of December autumn.

Yokohama is situated on a plain intersected by many cultivated valleys, the land seldom rising over 100 feet in elevation; to the north the plain extends about eighty miles to the Nikko range, the nearest mountain to Yokohama being Ohoyama, in Sagami, twenty-six miles distant west. This plain, which includes both Yokohama and Tokiyo districts, forms the province of Musashi.

Temperature.—The variations in course of the year,

at the same level, are very severe. We frequently have 10° to 12° of frost in the winter, and in summer the thermometer is frequently 88° to 90° Fah. in the shade, and the sun is then very powerful.

Papilio Xuthus and *Xuthulus*.—This insect is generally found feeding on the Karatachi (*Citrus trifoliata*), and Inusanchiyo (*Xanthoxylon schinnefolium*); it is very abundant, and a succession of broods appear during the year; the insect first appears as an imago in March (the larva having fed up in the colder period of the autumn); it is then the form known as *Xuthulus*: another brood begins to appear in June, and is intermediate in size and coloration between *Xuthulus* and *Xuthus*. This form has a dimorphic female, which is sometimes yellow and sometimes pale-coloured. The early *Xuthulus* form has a red spot at the anal angle of the hind wing which is quite lost in the summer broods, which are much larger and darker. I have specimens of the small temperature form *Xuthulus* under three inches in expanse, and of the large *Xuthus* over five inches. I took the *Xuthulus* form on the Ogasawara Islands (Bonins), 500 miles due south of Yokohama, in March, although the temperature there then was as warm as in June at Yokohama, proving that the cold during the time the insect had been in the larval stage had been sufficient to produce this form instead of the large dark *Xuthus* form. This species is abundant everywhere.

Papilio Machaon.—This insect feeds on the cultivated carrot, fennel, and other plants. The difference between the temperature forms is very striking; March specimens are about $2\frac{1}{2}$ to $2\frac{3}{4}$ in. in expanse and very pale-coloured, the summer forms expanding over five inches, and are very dark handsome insects. No alteration takes place in the markings, the colours being intensified only. It is very abundant everywhere.

Papilio Alcinous.—Feeds on a climbing-plant, I think a species of *Asclepiadææ*. The larva and pupa are very extraordinary; the first, when full-fed, has the appearance of a large mulberry, and the pupa looks more like a mollusc than the pupa of a lepidopterous insect. The imago first appears in April, and is generally then smaller than those appearing later on. This insect being almost unicolorous, cannot otherwise alter, except in size. I have noticed that the early spring male has rather an unpleasant sour smell, whereas the summer specimens

have a faint but very pleasant odour when alive. It is very abundant, and I have seen hundreds at a time on the wing, flying over the blossoming rape-fields, when the intense black of the male is very conspicuous over the bright yellow flowers.

Papilio macilentus.—First brood appears early in May; it is then very much smaller than those appearing in the summer months, but, being unicolorous, does not exhibit any alteration. I have taken it in May less than half the size of the summer broods. I have not yet detected the larva. Rare about Yokohama, but common in all the mountains.

Papilio Maacki.—Feeds upon the Karatachi (*Citrus trifoliata*), skimmer, and other trees; it is a very variable insect, and has the usual temperature forms, *Dehaani*, *Bianor*, and *tutanus* being some of the names it has received; they are all undoubtedly referable to one species. The cold temperature form is generally small and brightly coloured, the summer ones being larger and darker. Last year, in June, I took both the extreme forms on the same day. At Nikko, elevation about 2000 feet, the large summer form was abundant, but on ascending about 1500 feet more to Chiuzenji I found the smaller brightly-coloured form equally common.

Papilio Demetrius.—Feeds on the Karatachi (*Citrus trifoliata*) and other trees. The larvæ of *Xuthus*, *Demetrius*, and *Maacki* resemble each other very closely; the pupæ, however, can be readily distinguished; the food plants are also generally the same. The temperature forms of *Demetrius* vary as to size, but, being almost unicolorous, show no other differences. Abundant everywhere.

Gonepteryx rhamni.—There are two forms, the large one being found about Yokohama, and low down on Ohoyama; the smaller, sharply-pointed winged, form is found about Nikko, and generally high up in the mountains. Both forms hibernate.

Colias Hyale.—This has a very striking temperature form; it is very small, about $1\frac{3}{4}$ in. in expanse, and lightly coloured, whereas a large summer specimen will measure as much as $2\frac{1}{2}$ in. It is a very hardy insect, and first appears in February, in which month I have often captured newly-emerged specimens flying along a bank warmed by the sun, at the foot in the shade ice an inch thick being present, with patches of snow lying in all shady places. It is very abundant, and can be taken

nearly every month in the year, and is common in the mountains and on the plains. The female here, as in other species of *Colias*, is dimorphic, the white and a yellow form being equally abundant.

Pieris napi and *Melete*.—I think the latter will prove to be a temperature form of the first-named species, which only appears in March and April. *Melete* begins to put in an appearance in the latter part of May; subsequent broods increase in size and depth of coloration. I have round-winged May specimens $1\frac{7}{8}$ in. against $2\frac{1}{2}$ in. long-winged August specimens. There is as great a difference between May and August specimens of *Melete* as there exists between *Melete* and *napi*.

Pieris rapæ.—Appears first in March small and light-coloured; subsequent broods are larger, and in the female very darkly clouded at the base of the wing. I have, however, taken in July, about 3000 feet up Fujisan, smaller specimens than those obtained about Yokohama in March. Mr. Elwes in his list (Proc. Zool. Soc., 15th Nov., 1881) gives *Pieris brassicæ* as being found in Japan, but I have never seen either the imago, larva, or pupa of this insect here. His remarks refer to *rapæ*, which is very abundant. The food-plant, larva, and pupa do not differ from the home species.

Terias Hecabe, &c.—Six years ago, in March, I observed a hibernated specimen of *Terias Mandarinina* depositing its eggs on *Lespedeza junca*; I took these, and was much surprised by breeding from these eggs the black-bordered *Hecabe* form. At the time I thought some larvæ of *Hecabe* must have been accidentally introduced into the breeding-cages, and hesitated publishing the fact until I had verified it. This year I have repeated the experiment fully, and I am now in the position to assert positively that *Hecabe* and *Mandarinina* are one species. I obtained a number of the plants and potted them, after carefully examining every leaf for eggs or larvæ. I then caught a number of female *Mandarinina*, and enclosed them in a gauze house with the plants, and soon obtained a good supply of eggs. The perfect insects are now emerging, 1st to 20th June; no two specimens are exactly alike, and they comprise all the forms from Nos. 1 to 11 of Plate vi., Trans. Ent. Soc. Lond., 1880. Nos. 12 to 17 are the autumn forms, which hibernate. Sixteen specimens in all have emerged, eight females and eight males. It is a very remarkable fact that four of the specimens,

three females and one male, are the *Mandarina* form. I have never captured this form at this season of the year, or even seen anything approaching it, although twenty or thirty of the other forms are now brought in daily by my collector, to whom I have given special instructions to capture as many *Terias* as possible. Six specimens, five males and one female, are the *Hecabe* form as figured in the plate, Nos. 1 to 6; two specimens, both males, represent figures 7 to 11; and one female can also be placed in the same rank. One female would do for either forms, Nos. 1 to 6 or 7 to 11, as it unites both in having a more distinctly marked black edge on the right wing than on the left wing; the remaining specimen, a female, is quite a new form intermediate between Nos. 7 to 11 and 12 to 17. This insect is, therefore, very sensitive to temperature influences, and I believe it is owing to my having reared these specimens in a cold room, without much direct sunlight, that I have been so successful in procuring all these forms from a single lot of eggs. Although I am perfectly aware that I shall be charged with perpetrating a serious scientific solecism, still, taking into consideration the exceptionally large numbers of forms of this insect which have been described as distinct species, I venture on proposing yet another name, and uniting all those hitherto described under the name of *Terias multiformis*.

Terias multiformis, viz. :—

	<i>Terias</i>	<i>Hecabe</i>	
		<i>Mandarina</i>	} See Mr. Elwes' Catalogue, Proc. Zool. Soc., Nov. 15th, 1881.
		<i>Hecabeoides</i>	
		<i>sinensis</i>	
Japan . . .		<i>Mariesii</i>	} Mr. A. G. Butler, Trans. Ent. Soc. Lond. 1880, p. 197.
		<i>Anemone</i>	
		<i>connexiva</i>	
		<i>hybrida</i>	
Australia . .		<i>Æsiope</i>	} Rev. R. P. Murray, Trans. Ent. Soc. Lond. 1875, p. vii.
West Africa .		<i>Brenda</i>	
Malacca . . .		<i>Sari</i>	

Terias senegalensis is given in the Catalogue of the Hewitson Collection, one specimen from Japan. I should like to know whether it can be referable to *Terias multiformis*. I have two specimens of a *Terias* from Singapore marked like the *Hecabe* form, but with fore wings more rounded than the usual Japanese specimens.

I have, however, two Japanese specimens which differ from each other in markings, but which are nearly as round-winged as those from Singapore. I shall be greatly obliged for notes on the genus *Terias*, and specimens from any part of the world, for which I shall be glad to send Japanese insects. The remaining species of Japanese *Terias* are *Terias Betheseba*, which appears only in summer, and *Terias Læta*, which is out all the year round, hybernating in the winter. I have a specimen, and Mr. Ota has another, without the black marking on the tip of the wing.

Leucophasia vibilia I obtained, in considerable quantities, from Nambu, in the north of the main island; it may be a temperature form of *sinapis*, as Mr. Elwes suggests, but I cannot say for certain.

Lethe Sicclis and *Diana*.—The latter is, I think, a temperature form of *Sicclis*; *Diana* is only found in the mountains, *Sicclis* on the plains. The difference between the two forms is in colour and size only; the markings are identical; both are very abundant in their respective localities.

Neope Goschkeritschii.—This also has a dark temperature form found in the mountains. I have taken it high up on Ohoyama, when the paler plain form at the foot of the mountain was very much worn. It is a very abundant insect.

Ypthima Baldus.—I have two forms, both taken about Yokohama; one is light on the under side, and is very abundant; the other is as dark on the under side as it is above.

Limenitis Sibylla.—I have specimens from Fujisan with a large distinct white stigma. Yokohama specimens sometimes exhibit a trace of this stigma.

Vanessa C-aureum and *Pryeri* are undoubtedly identical. *Pryeri* is a temperature form which appears in the autumn, and hybernates; it feeds on the cultivated hemp. Difference in the shape of the wings of the two forms is very noticeable. It is a very abundant insect on the plains.

Vanessa C-album, *Fentoni*, and *hamigera*.—I quite agree with Mr. Elwes in thinking that these are all forms of one species. The difference between *Fentoni* and *hamigera* is exactly the same as between *C-aureum* and *Pryeri*. I have not taken either *Fentoni* or *hamigera*, but I believe Mr. Fenton informed me that *Fentoni* was found

high up in the Asamayama district, *hamigera* being confined to the foot of the range.

Polyommatus Phlæas.—This insect is very strongly affected by temperature; the first brood, which appears in March, is very brightly coloured; the latter summer broods, in the male, are almost black.

Lycæna Argiolus.—The late broods are generally larger than the first, which appears very early in the year. The females are in summer especially large and dark; two forms, however, then appear, one dark, and a much brighter form.

Lycæna Argia and *Japonica* are, I believe, identical. *Japonica* appears late in the autumn, and again in the spring; it is then replaced by *Argia* in summer.

In conclusion I would remark that neither size, shape, nor colour can be relied upon as sufficient guides for specific distinction, and that temperature has a great evolutionary effect in the character of insects, but this has hitherto been greatly obscured owing to the misdirected zeal of various entomologists who have hastened to describe insects as new species without sufficient investigation.